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grandams and offspring, but it is impossible to assert any trustworthy correlation for the other grandparents.

INFLUENCE OF ENVIRONMENT ON FERTILITY

Marshall[34] while emphasizing the importance of the hereditary factor in multiple births in sheep, adduces evidences for the great importance of feeding as a factor in the production of twins and triplets. His figures certainly show great and consistent differences in the produce of flocks which have received different treatment at and preceding tupping time. Unfortunately differences in breed may, but do not necessarily, cast some doubt on the interpretation of the data. The problem which he has attempted to solve by the analysis of schedules received from flock masters certainly deserves experimental study. Such investigations have actually been begun by Evvard who in a first[35] and second[36] and third[37] report on experiments with swine has given the results of various feeding upon the vitality of the offspring. Discussion of the data as they are presented in these papers falls outside the scope of a biometric review. Such work is, however, of great importance at a period of science in which heredity as contrasted with environment is apt to be assumed to be an all-important factor. It is a pity that such experiments as these of Marshall and Evvard can not be carried out in close cooperation with experts on the physiology of nutrition, so that differences in rations might be arranged on a uniform scale.

J. ARTHUR HARRIS

ON A BARNACLE, CONCHODERMA VIRGATUM, ATTACHED TO A FISH, DIODON HYSTRIX[1]

A SPECIMEN of the "sea porcupine," *Diodon hystrix* Linn., seen swimming near the surface and secured with a dipnet, was

[34] Marshall, F. H. A., "Fertility in Scottish Sheep," *Trans. High. Agr. Soc. Scotland*, V, 20: 139–151, 1908.

[35] Evvard, J. M., "Nutrition as a Factor in Fetal Development," *Proc. Amer. Breed. Ass.*, 8: 549–560, 1912.

[36] Evvard, J. M., "Some Factors affecting Fetal Development," *Proc. Iowa Acad. Sci.*, 20: 325–330, 1913.

[37] Evvard, J. M., A. W. Dox and S. C. Guernsey, "The Effect of Calcium and Protein Fed Pregnant Swine upon the Size, Vigor, Bone, Coat and Condition of the Offspring," *Proc. Iowa Acad. Sci.*, 21: 269–278, pl. 31–35, 1914.

[1] Contributions from the Bermuda Biological Station for Research, No. 50.

found to have two living lepad barnacles attached to one of its erectile spines[2] upon the ventral surface two centimeters to the right anteriad of the anus. The *Diodon* was a small individual, 16 cm. long. It was kept under observation in the laboratory for several weeks.

According to a determination for which I am indebted to Mr. H. G. Coar, the barnacles belong to the species *Conchoderma virgatum* (Spengler), although varying "a trifle from Gruvel's type description, but not sufficiently to correspond to *Conchoderma hunteri* R. Owen, 1830, which the specimen approached slightly, nor to Leach's (1818) variety *chelonophilus* of *C. virgatum.*" This species has not previously been recorded from the Bermuda area, though it is known over the Atlantic generally and (to judge from statements of fishermen) occurs here upon young turtles. *C. virgatum* has been found on *Mola,* ships' bottoms, and various other objects (Pilsbry, 1907, p. 99), but the present record is somewhat unusual.

Different semiparasitic lepads have quite various hosts, such as medusæ, antipatharians, the spines of echinoids, molluses, crustaceans, sharks, teleosts, turtles, the tail feathers of sea birds, whales, and so forth (Pilsbry, 1907; 1910). Those occurring on fishes seem, naturally, to affix themselves to some hard part, for example, the head, as in the case of *Tylosurus* (Sumner, Osburn, and Cole, 1913, p. 647). Jordan (1905, p. 341, fig. 226) figures a flying fish with conchodermas attached to a *Penella* growing on the fish, a condition of double parasitism which has been described for Xiphias. In the present instance, the larger of the two conchoderma individuals (20 mm. long) was found to have its peduncle completely surrounding the spine to which it had become fixed. The second individual was much smaller (4 mm. long) and attached to the peduncle of the first. Both specimens were so oriented that the opening between the valves was directed toward the head of the fish. The skin of the fish about the base of the spine was inflamed, and the muscles which normally control its elevation for defensive purposes had apparently degenerated. When it was attempted to preserve the *Diodon,*

[2] The figure of *Diodon hystrix,* which is used in current ichthyological handbooks, represents the animal in a semipuffed-up condition and with the frontal spines erected. Alive, the fish has a quite different aspect, all the spines being flattened down to the skin unless the creature is much disturbed. When preserved in formalin it assumes the appearance depicted in the handbooks.

the spine bearing the conchodermas became detached in the course of the animal's self-inflation. It is probable, therefore, that the spine would soon have been shed under natural circumstances.

Several features of the behavior of these conchodermas are of interest in comparison with those of other barnacles. Some years ago it was reported by Pouchet et Joubert (1876) that cirripedia attached to rocks reacted to shading, while those attached to floating objects did not; their inference being that to the stationary barnacles a shadow signified danger, whereas, to those borne about at the surface of the water, a fluctuating illumination was the normal state of affairs. This observation has been regarded as an instance of adaptation comparable with that of Hargitt (1909) on the gradual loss of reaction to shading when serpulids are maintained in the laboratory.

The specimens of *Conchoderma* attached to *Diodon* did not react to shadows under any of a number of experimental conditions. They seem, therefore, to be in agreement with the observation of Pouchet et Joubert. But tests upon lepads found upon floating timbers and upon *Ascophyllum* showed that *Lepas anserifera* and *L. pectinata* do respond to shading by retracting the legs and approximating the valves. From a number of tests it appeared that neither the legs nor valves are sensitive to shading, but that the shadow must affect some part of the body within the shell suggesting that the persisting nauplius eye is the organ involved. The extent of the response varies with the degree to which the appendages have been extruded: when just being extruded, they react by complete retraction; when fully extruded, by a partial retraction; after being fully extruded for one or two minutes, they react to shading quite promptly and completely. After completion of a response there must usually elapse from two to four minutes before another reaction can be secured.

It seems to me, then, that the supposed adaptation of floating barnacles is not of the nature which has been supposed. Whether the non-reaction of *Conchoderma* to shading is properly to be considered a direct adaptation is therefore questionable. The host of these particular specimens is not a surface fish, and the absence of sensitivity to shading may be due to their deep habitat. Direct sunlight inhibited the rhythmic movements of the conchodermas, and they were much more active at night than in diffuse laboratory light.

The statement is occasionally met with that in barnacles attached to a free-swimming animal the feathery feet are merely thrust out, not waved about as in the rock barnacles, which must create food- and respiratory-currents for themselves. Now, it was observed that when the *Diodon* bearing the conchodermas was actively swimming, the legs of the lepads remained extended for as much as four to five minutes; whereas, when the fish remained stationary, they were alternately extended and retracted about seven times every minute (at 18° C.), the extension in the latter case being not so great as when their host was moving. *Lepas anserifera* and *L. pectinata* were then tested as to their behavior in currents, with this result: when the wood to which they were attached was stationary, the rhythmic contraction of the appendages was continuous, but if a gentle stream of water from a supply jet was allowed to flow past them impinging on the anterior (concave) edges of the legs, they remained extended for as long as ten minutes, and were spread farther apart than in the absence of the current. This was not due to any merely mechanical effect of the water stream, as the feet could at any time be caused to contract at a touch. A water stream, striking the posterior (convex) edges of the legs, led to contraction and subsequent limited extrusion of these appendages. A more correct interpretation of the phenomenon described in floating barnacles seems to be, therefore, that when the concave side of the appendages is stimulated by a water current, the animal responds by pushing out its legs further than is usual in the absence of currents, while their rhythmic contraction is inhibited. It should be noted that the two specimens of *Conchoderma* observed were so oriented on the *Diodon* as to receive the full benefit of currents derived from its forward swimming; and further, that this fish is not a vigorous swimmer, so that the currents in question are by no means rapid, but rather such as could be efficiently strained by the barnacles.

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